US009349551B2

(12) **United States Patent**
Nakajima

(10) **Patent No.: US 9,349,551 B2**
(45) **Date of Patent: May 24, 2016**

(54) **KEYBOARD WITH ELASTIC MEMBER DISPOSED ON TOUCH PANEL**

(75) Inventor: **Takashi Nakajima**, Shinagawa (JP)

(73) Assignee: **FUJITSU COMPONENT LIMITED**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 210 days.

(21) Appl. No.: **13/596,554**

(22) Filed: **Aug. 28, 2012**

(65) **Prior Publication Data**

US 2013/0050095 A1 Feb. 28, 2013

(30) **Foreign Application Priority Data**

Aug. 31, 2011 (JP) 2011-189407

(51) **Int. Cl.**

G06F 3/02	(2006.01)
H01H 13/70	(2006.01)
H01H 13/703	(2006.01)
H01H 13/702	(2006.01)
H01H 13/704	(2006.01)
G06F 3/045	(2006.01)

(52) **U.S. Cl.**

CPC ***H01H 13/703*** (2013.01); ***G06F 3/0202*** (2013.01); ***G06F 3/045*** (2013.01); ***H01H 13/702*** (2013.01); ***H01H 13/704*** (2013.01); *G06F 2203/04809* (2013.01); *H01H 2209/004* (2013.01); *H01H 2221/054* (2013.01)

(58) **Field of Classification Search**

CPC G06G 2203/04809; G06G 2200/1634; H01H 13/702; H01H 13/704; H01H 2209/009; H01H 2221/004; H01H 2221/054; H01H 2221/076; H01H 2209/004; H01H 13/703

USPC 400/714, 473, 491, 472

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,527,021	A *	7/1985	Morikawa et al.	200/5 A
5,010,213	A *	4/1991	Moriwaki et al.	178/18.05
5,518,078	A *	5/1996	Tsujioka et al.	178/18.05
6,259,044	B1 *	7/2001	Paratore et al.	200/5 A
8,094,806	B2 *	1/2012	Levy	379/368
2010/0315343	A1	12/2010	Lau	

FOREIGN PATENT DOCUMENTS

JP	58-010335	U	7/1981	
JP	06161660	A *	6/1994	G06F 3/033
JP	09-17278	A	1/1997	
JP	09017278	A *	1/1997	H01H 13/70

(Continued)

OTHER PUBLICATIONS

Notification of Reasons for Refusal for Application No. 2001-189407 dated Apr. 14, 2015.

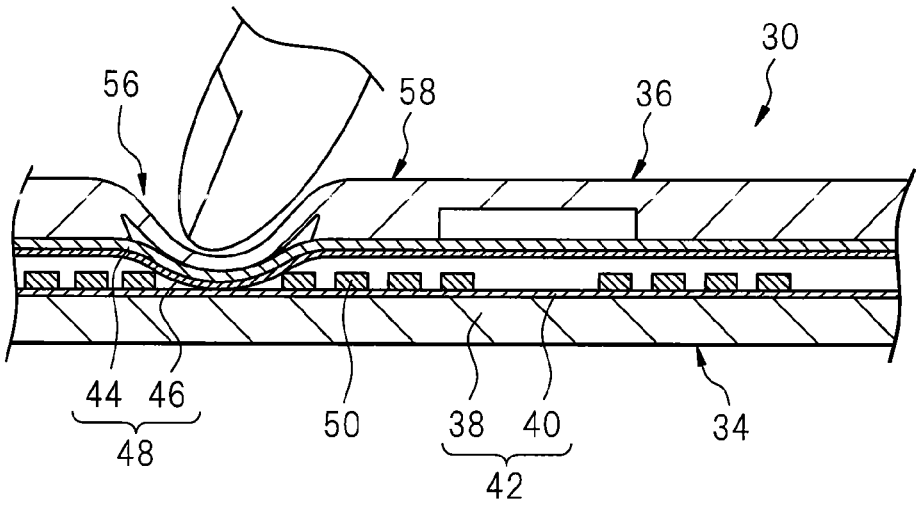
Primary Examiner — Daniel J Colilla

(74) *Attorney, Agent, or Firm* — Staas & Halsey LLP

(57) **ABSTRACT**

A keyboard including a touch panel having an input operation surface; and an elastic plate-like member disposed and superimposed on the input operation surface of the touch panel. The elastic plate-like member is locally and elastically deformable by a pressing force. The elastic plate-like member includes an input region adapted to be elastically deformed toward the input operation surface by the pressing force so as to permit input operation of the touch panel, and a non-input region not permitting input operation of the touch panel irrespective of presence or absence of elastic deformation by the pressing force.

12 Claims, 8 Drawing Sheets



(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	09044304	A *	2/1997	..... G06F 3/033
JP	09292943	A *	11/1997	..... G06F 3/03
JP	09-325859	A	12/1997	
JP	2004-134309	A	4/2004	
JP	2008-77850	A	4/2008	
JP	2009-193859	A	8/2009	
JP	2010-61425		3/2010	
JP	2011-100259		5/2011	
JP	3169346	U	7/2011	

* cited by examiner

FIG.1

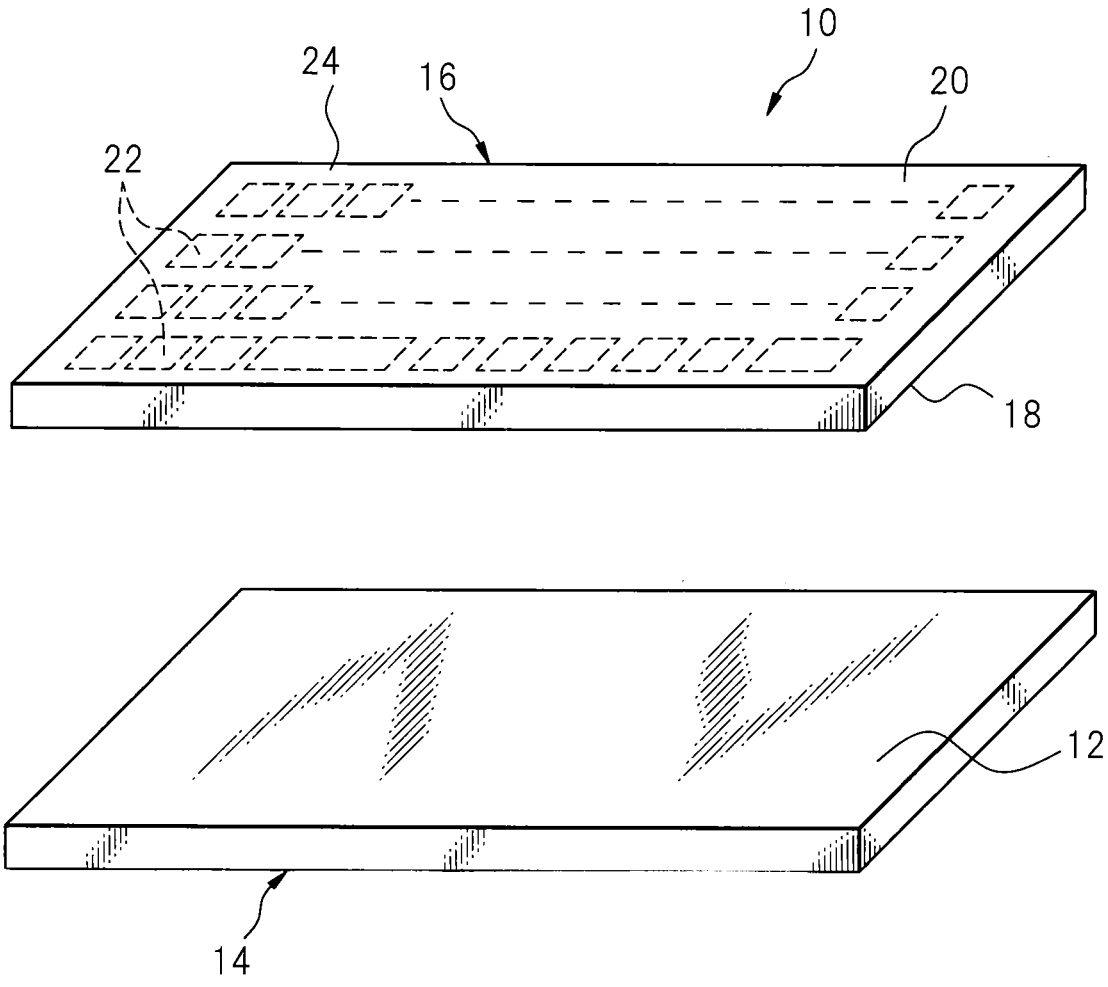


FIG.2A

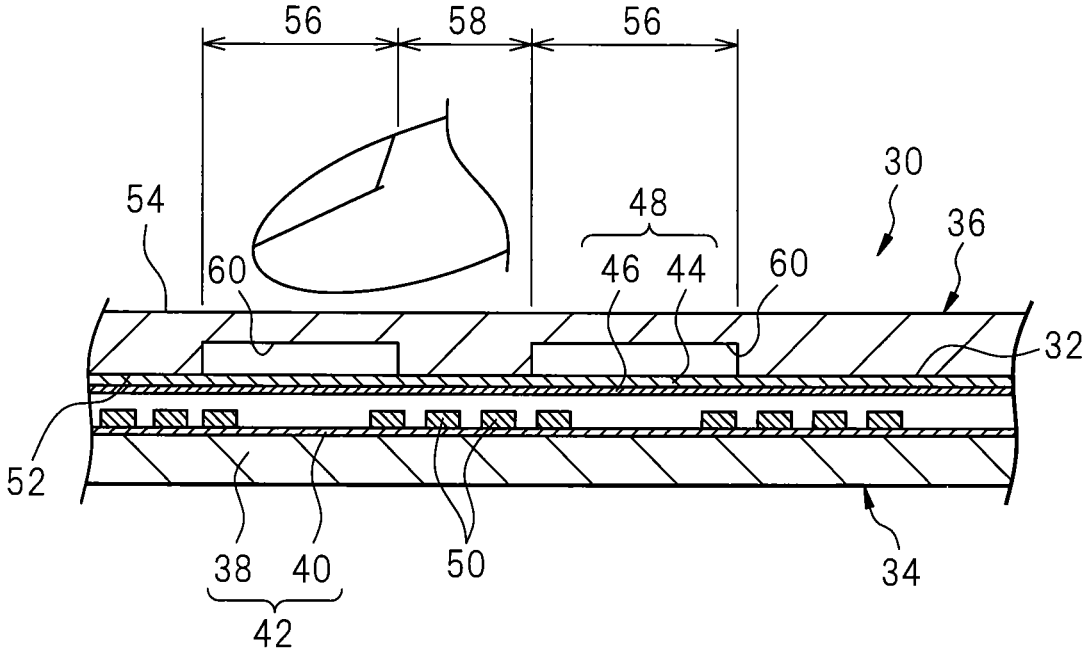

56
58
56
30
54
48
36
60
46
44
60
32
52
38
40
50
34
42

FIG.2B

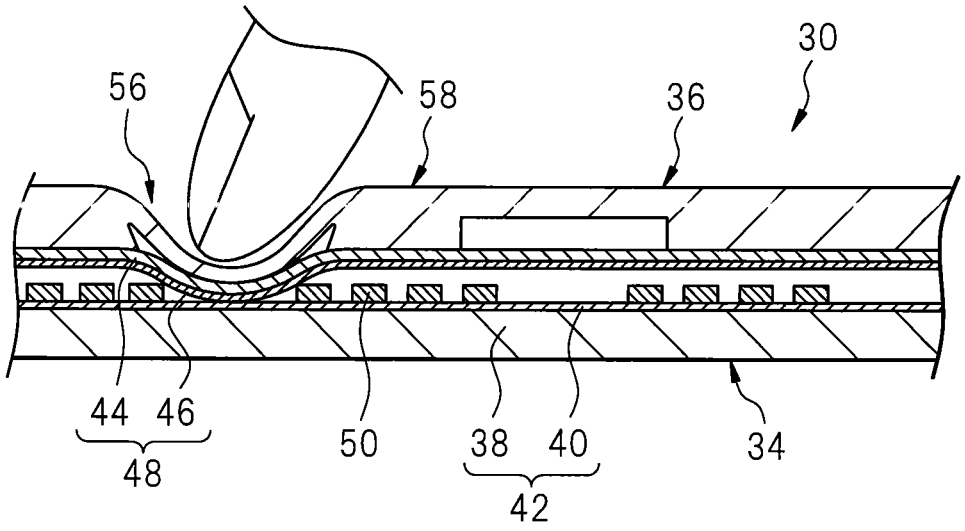

30
56
58
36
44
46
50
38
40
34
48
42

FIG.3

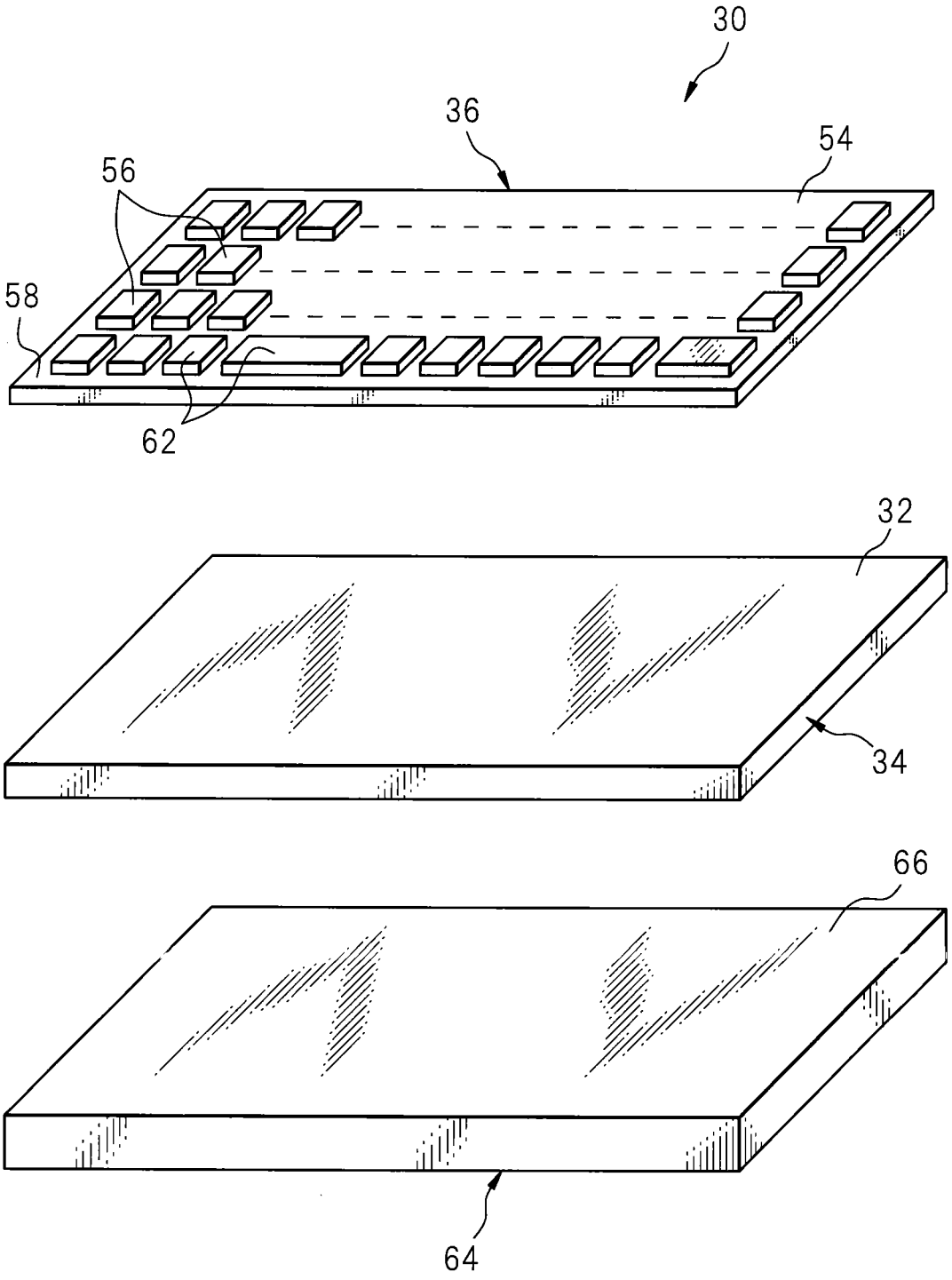


FIG.4

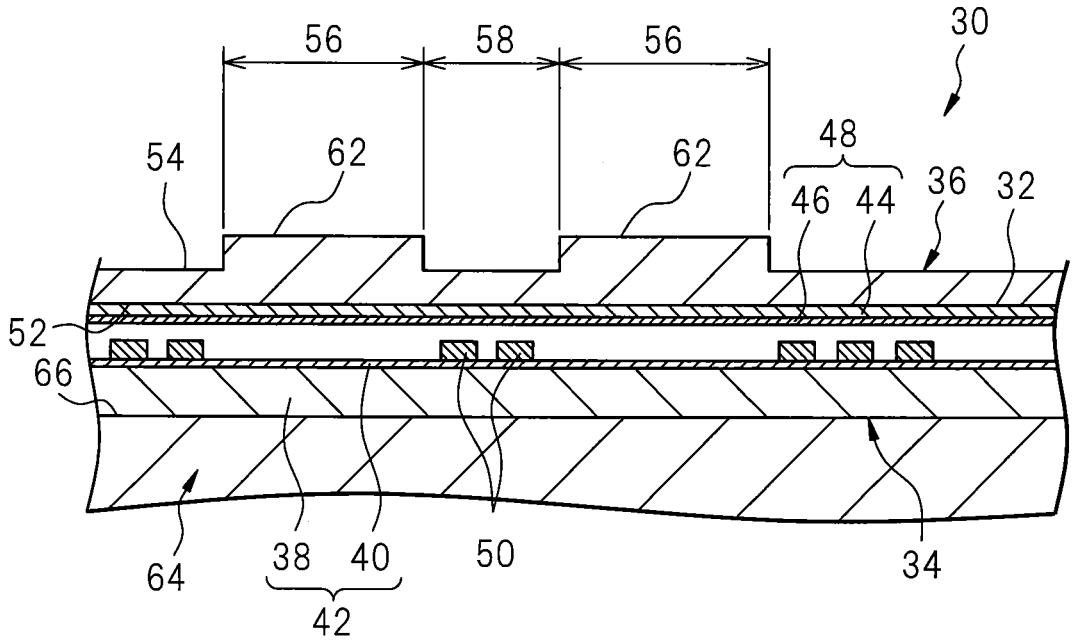

56
58
56
30
48
54
62
62
46
44
36
32
52
66
64
38
40
42
50
34

FIG.5

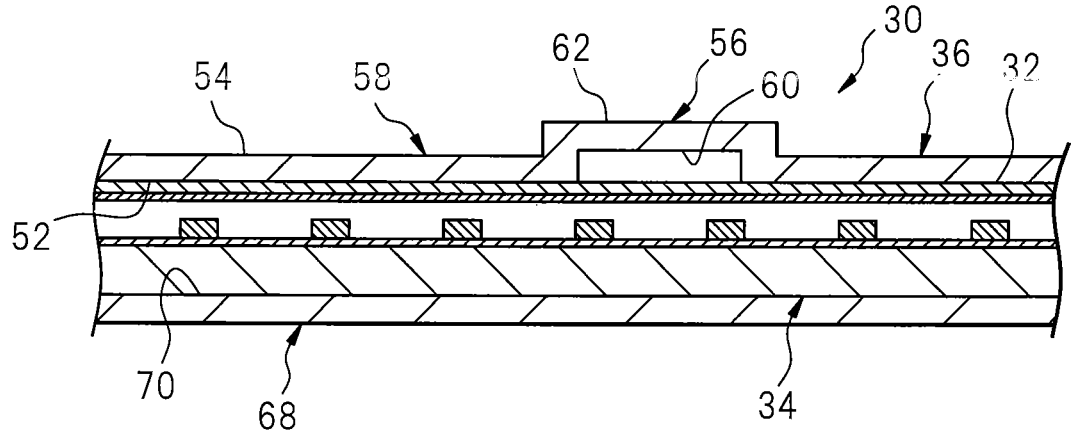

30
62
56
36
32
54
58
60
52
70
68
34

FIG.6

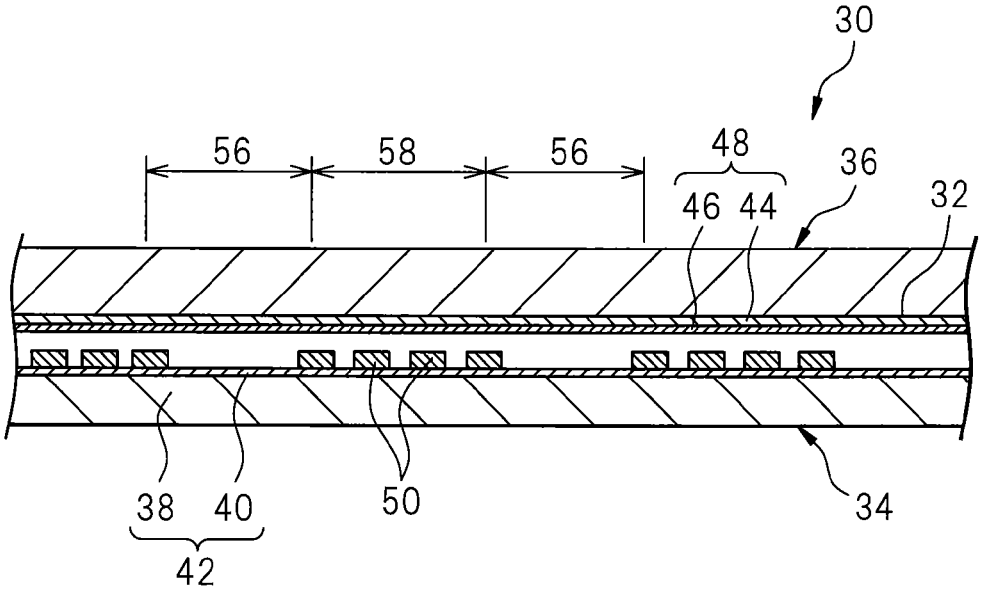

30
56
58
56
48
46
44
36
32
38
40
42
50
34

FIG.7

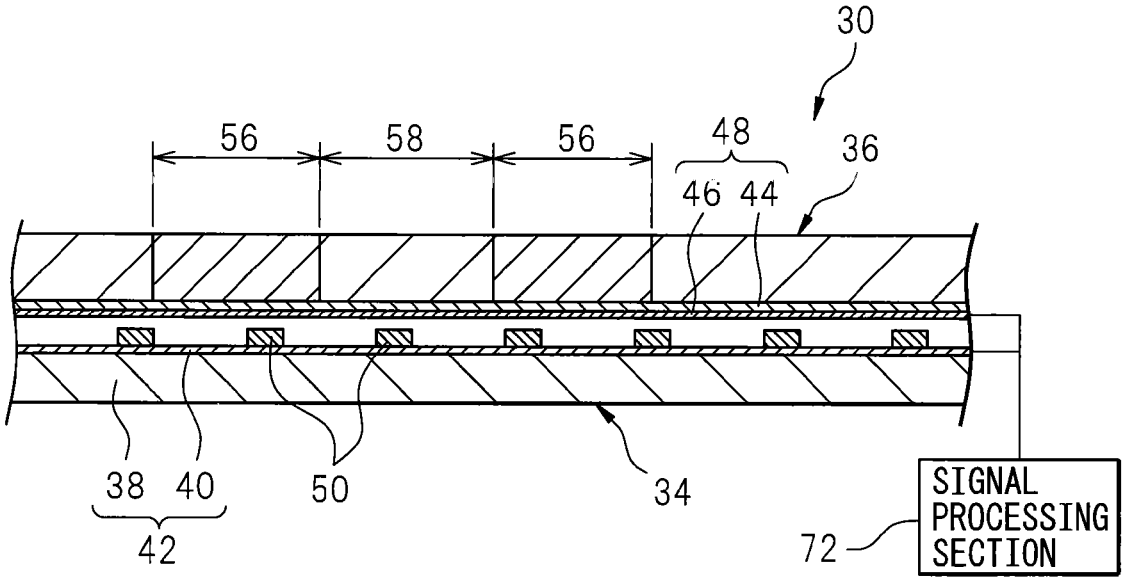

30
56
58
56
48
46
44
36
38
40
42
50
34
72
SIGNAL PROCESSING SECTION

FIG.8A

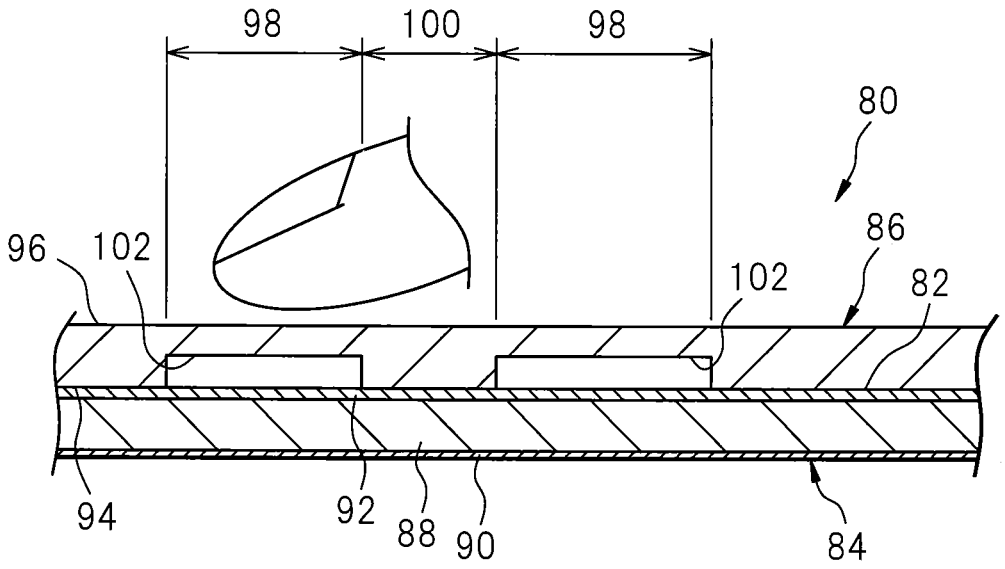


FIG.8B

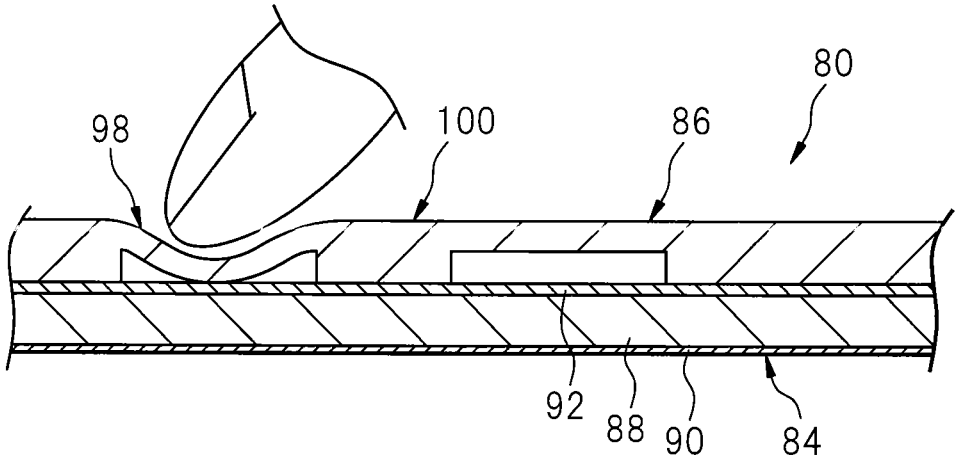


FIG.9

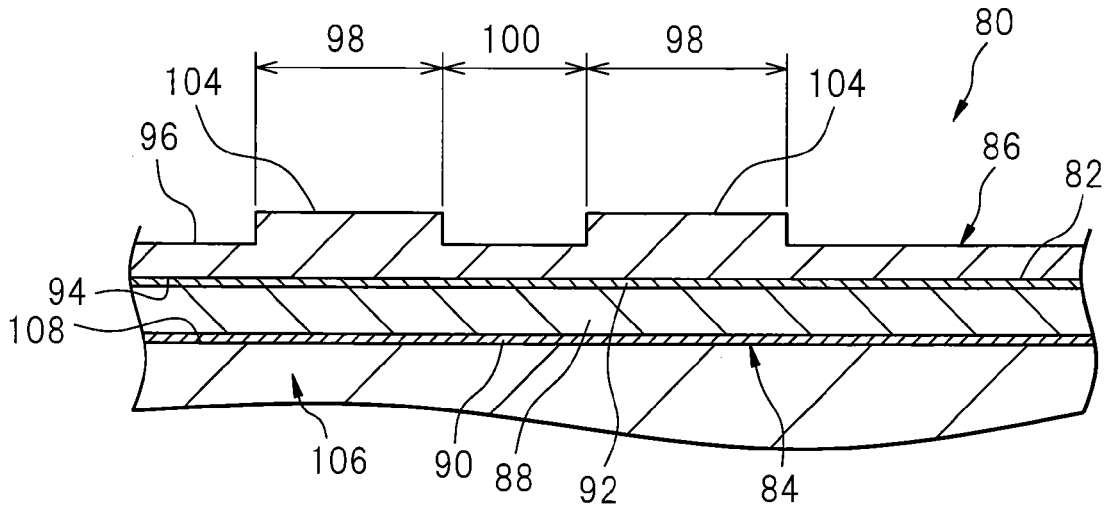

98
100
98
80
104
104
96
86
82
94
108
106
90
88
92
84

FIG.10

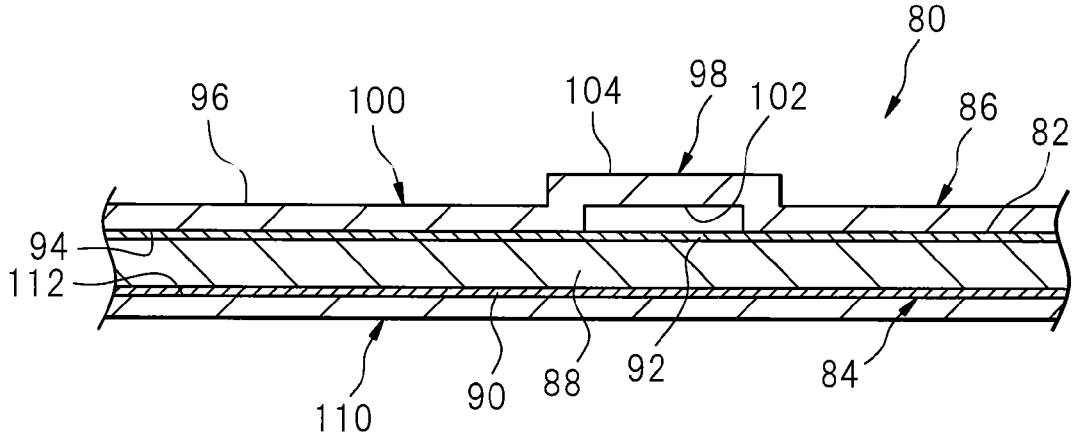

80
96
100
104
98
102
86
82
94
112
110
90
88
92
84

FIG.11

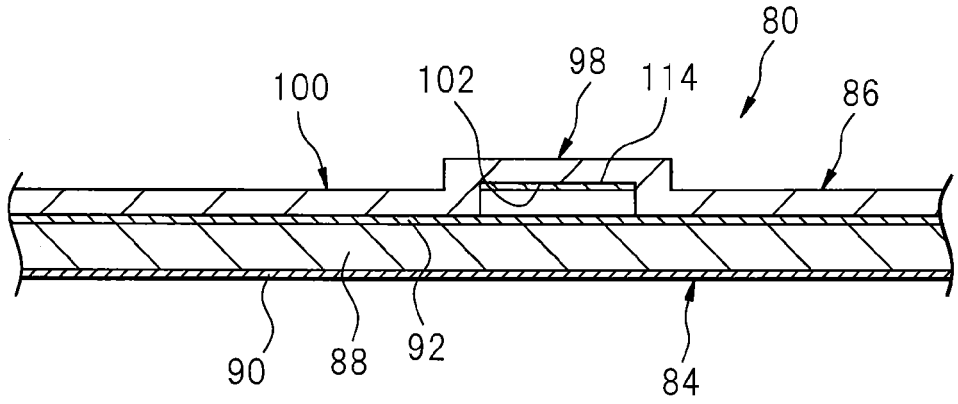
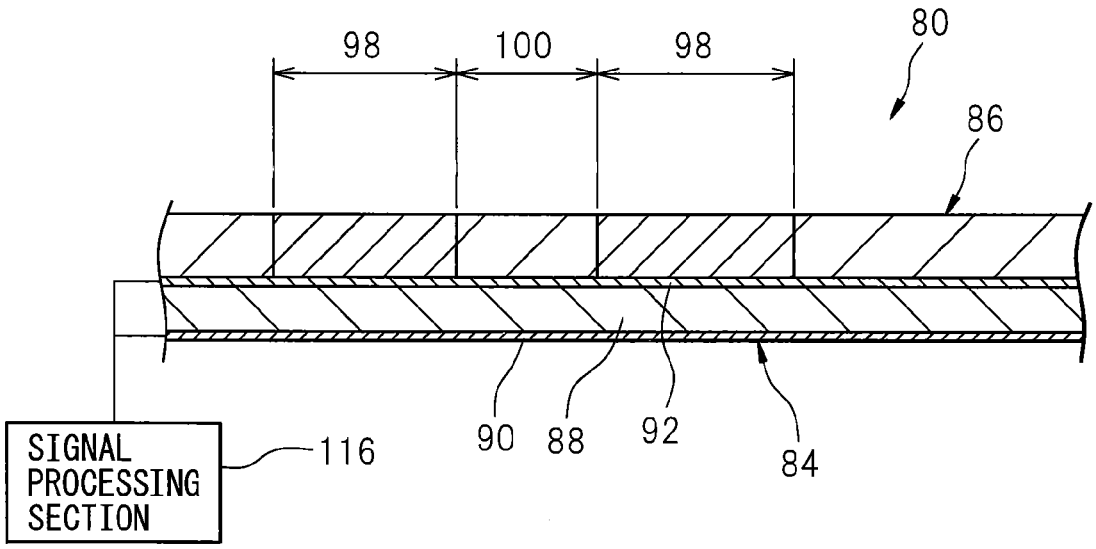

80
100
102
98
114
86
90
88
92
84

FIG.12


98
100
98
80
86
SIGNAL PROCESSING SECTION
116
90
88
92
84

KEYBOARD WITH ELASTIC MEMBER DISPOSED ON TOUCH PANEL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority of the prior Japanese Application No. 2011-189407, filed Aug. 31, 2011, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a keyboard.

2. Description of the Related Art

A flat input keyboard has been known as a keyless keyboard used as an input device for an electronic apparatus such as a personal computer, which enables a key entry operation to be carried out by the function of a touch panel for designating two-dimensional coordinate data, instead of a mechanical key switch using, e.g., a membrane switch (see, e.g., Japanese Unexamined Patent Publication (Kokai) No. 2011-100259 (JP2011-100259A). A touch panel is a panel-type input device (or a coordinate detection device) that can designate two-dimensional coordinate data corresponding to a desired point on a panel surface, to which an operator presses or contacts a pen or a finger.

Generally, irrespective of the types of detecting coordinate data, such as a resistive type, capacitive type, etc., a touch panel has a flat outer surface of an outermost plate-like member (a glass plate, a plastic plate, or a plastic film, etc.) of a panel structure, which serves as an input operation surface adapted to be operated by a pen or a finger. Since the input operation surface is the outer surface of a plate-like member and a touch panel generally has no flexibility in its entirety, a relatively stiff feeling is given on, e.g., the finger from the input operation surface at the time of an input operation. For example, Japanese Unexamined Patent Publication (Kokai) No. 2010-061425 (JP2010-061425A) describes a capacitive-type touch panel provided with an outermost layer having elasticity and made of, e.g., silicone resin, in which, when a user presses the touch panel, the elastic outermost layer is deformed and dented, so as to improve an operational feeling.

SUMMARY OF THE INVENTION

In a flat input keyboard including a touch panel, it is desired to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger, such as a keying stroke or a click feeling in a characteristic key entry operation of a mechanical key switch.

One aspect of the present invention provides a keyboard comprising a touch panel having an input operation surface; and an elastic plate-like member disposed and superimposed on the input operation surface of the touch panel, the elastic plate-like member being locally and elastically deformable by a pressing force; wherein the elastic plate-like member includes an input region adapted to be elastically deformed toward the input operation surface by the pressing force so as to permit input operation of the touch panel, and a non-input region not permitting input operation of the touch panel irrespective of presence or absence of elastic deformation by the pressing force.

In the above keyboard, the input region may have a thickness less than a thickness of the non-input region, and the elastic plate-like member may include a recess formed on an inner surface facing the input operation surface of the touch panel, the recess being provided to the input region due to a difference in thickness between the input region and the non-input region.

In the above keyboard, the input region may have a thickness greater than a thickness of the non-input region, and the elastic plate-like member may include a protrusion formed on an outer surface not facing the input operation surface of the touch panel, the protrusion being provided to the input region due to a difference in thickness between the input region and the non-input region.

In the above keyboard, the elastic plate-like member may include a recess formed on an inner surface facing the input operation surface of the touch panel and provided to the input region, and a protrusion formed on an outer surface opposite to the inner surface and provided to the input region correspondingly to the recess.

In the above keyboard, the input region and the non-input region may comprise mutually different material properties.

In the above keyboard, the touch panel may comprise a pair of electrode plates each including a substrate and a conductive coating provided on a surface of the substrate, the pair of electrode plates being combined with each other in a relative arrangement such that conductive coatings are opposed to and spaced from each other while permitting a conductive contact between the conductive coatings, and a plurality of dot spacers arranged in a dispersed manner between mutually opposing conductive coatings of the pair of electrode plates. In this configuration, a density of the dot spacers in a region corresponding to the input region of the elastic plate-like member may be lower than a density of the dot spacers in a region corresponding to the non-input region of the elastic plate-like member.

In the above keyboard, the touch panel may comprise a pair of electrode plates each including a substrate and a conductive coating provided on a surface of the substrate, the pair of electrode plates being combined with each other in a relative arrangement such that conductive coatings are opposed to and spaced from each other while permitting a conductive contact between the conductive coatings. In this configuration, the keyboard may further comprise a signal processing section adapted to cancel an input signal of the touch panel in a region corresponding to the non-input region of the elastic plate-like member.

In the above keyboard, the touch panel may comprise a single conductive coating or a pair of conductive coatings arranged to be opposed to and insulated from each other. In this configuration, the keyboard may further comprise a signal processing section adapted to cancel an input signal of the touch panel in a region corresponding to the non-input region of the elastic plate-like member.

In the above keyboard, the input region of the elastic plate-like member may be provided with an auxiliary conductive coating insulated from the conductive coatings of the touch panel.

According to the above keyboard, an operator can indirectly perform an input operation to a desired position on the input operation surface of the touch panel via the input region of the elastic plate-like member. Therefore, due to the elastic deformation amount and/or elastic reaction force of the input region and a region adjacent thereto of the elastic plate-like member, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger, such as a keying stroke or a click feeling obtained in a characteristic key entry operation of a mechanical key switch. Since a

keying operation is not performed directly on the input operation surface of the touch panel but on the outer surface of the elastic plate-like member, it is possible to reduce noise associated with the keying operation and also mitigate impact on and/or fatigue of a finger of the operator.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following description of the embodiments in connection with the accompanying drawings, wherein:

FIG. **1** is an exploded perspective view schematically depicting a flat input keyboard according to an embodiment of the present invention;

FIG. **2**A is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to another embodiment of the present invention, in a state before being subjected to an input operation;

FIG. **2**B is a cross-sectional view schematically and diagrammatically depicting the flat input keyboard of FIG. **2**A, in a state during the input operation;

FIG. **3** is an exploded perspective view schematically depicting a flat input keyboard according to still another embodiment of the present invention;

FIG. **4** is a cross-sectional view schematically and diagrammatically depicting the flat input keyboard of FIG. **3**;

FIG. **5** is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to a further embodiment of the present invention;

FIG. **6** is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to an yet further embodiment of the present invention;

FIG. **7** is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to an yet further embodiment of the present invention;

FIG. **8**A is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to an yet further embodiment of the present invention, in a state before being subjected to an input operation;

FIG. **8**B is a cross-sectional view schematically and diagrammatically depicting the flat input keyboard of FIG. **8**A, in a state during the input operation;

FIG. **9** is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to an yet further embodiment of the present invention;

FIG. **10** is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to an yet further embodiment of the present invention;

FIG. **11** is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to an yet further embodiment of the present invention; and

FIG. **12** is a cross-sectional view schematically and diagrammatically depicting a flat input keyboard according to an yet further embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENT

The embodiments of the present invention are described below, in detail, with reference to the accompanying drawings. In the drawings, the same or similar components are denoted by common reference numerals.

Referring to the drawings, FIG. **1** schematically depicts a flat input keyboard **10** according to one embodiment of a keyboard. The flat input keyboard **10** includes a touch panel **14** having an input operation surface **12**, and an elastic plate-like member **16** disposed and superimposed on the input operation surface **12** of the touch panel **14**, the elastic plate-like member **16** being locally and elastically deformable by a pressing force applied thereon.

The touch panel **14** is a known panel-type input device (or a coordinate detection device) that detects a two-dimensional coordinate value of an input position on the input operation surface **12**, by various types of methods for detecting an input coordinate value, such as a resistive type, a capacitive type, etc. The input operation surface **12** is formed by a flat outer surface of an outermost plate-like member (a glass plate, a plastic plate, or a plastic film, etc.) of the touch panel **14**. The touch panel **14** may have a transparent structure that can be placed on top of the screen of a display unit such as an LCD (not depicted), or an opaque structure adapted to be used separately of the display unit. The configuration of the touch panel **14**, such as the coordinate detection type, is not particularly limited.

The elastic plate-like member **16** is a flat platy member capable of being placed on the input operation surface **12** so as to preferably entirely cover the input operation surface **12** of the touch panel **14**, and includes an inner surface **18** facing the input operation surface **12** and an outer surface (i.e., an exposed surface) **20** opposite to the inner surface **18** and not facing the input operation surface **12**. The elastic plate-like member **16** is provided with an input region **22** adapted to be elastically deformed toward the input operation surface **12** by a pressing force so as to permit an input operation to be carried out in the touch panel **14**, and a non-input region **24** not permitting an input operation to be carried out in the touch panel **14** irrespective of the presence or absence of the elastic deformation thereof by the pressing force.

The elastic plate-like member **16** is made of a material such as silicone, polyurethane, etc., which can be elastically deformed locally (i.e., in a limited region including a pressed point and a portion adjacent thereto) by an appropriate pressing force applied to a desired point on the outer surface **20**. The material, shape and size of the elastic plate-like member **16** are selected so as to satisfy a requirement that at least the input region **22** can be elastically deformed, due to a pressing force in a predetermined range, to the extent sufficient to carry out the input operation of the touch panel **14**. The range of the pressing force required to elastically deform at least the input region **22** of the elastic plate-like member **16** to the extent sufficient to carry out the input operation of the touch panel **14** may be set so as to correspond to the range of a force required to depress a mechanical key switch by a key entry operation generally set in a keyboard having the mechanical key switch.

The elastic plate-like member **16** may be transparent, or translucent or opaque. The elastic plate-like member **16** may be bonded to the touch panel **14** with a suitable adhesive. Alternatively, the elastic plate-like member **16** may be formed from a self-adhesive material, so as to eliminate the use of an adhesive. The configuration of the elastic plate-like member **16**, such as the material, shape, size, etc., is not particularly limited, except for the requirements described above.

In the flat input keyboard **10**, the input region **22** of the elastic plate-like member **16** constitutes a key to be subjected to a key entry operation by an operator. FIG. **1** illustrates a plurality of input regions **22** (i.e., regions enclosed by dashed lines) provided in accordance with a specific key arrangement standardized by, e.g., JIS, and a non-input region **24** surrounding the input regions **22**. Characters, numbers, symbols, etc. (not depicted), can be indicated in the input regions **22** by, e.g., a screen display on a display unit (not depicted) provided on a side opposite to the input operation surface **12** of the touch panel **14** facing the elastic plate-shaped member **16**, a print display on the input operation surface **12** of the touch

panel **14**, a print display on the elastic plate-like member **16**, an insertion of a printed sheet (not depicted), etc.

In the flat input keyboard **10**, an operator can perform a keying operation to press a desired input region **22** of the elastic plate-like member **16** while referring to a key display indicated on the input region **22**. The input region **22** elastically deforms in response to the keying operation by the operator and, when the pressing force of the keying operation exceeds a predetermined threshold value, accomplishes an input operation on the input operation surface **12** of the touch panel **14** at the position corresponding to the pressed or deformed input region **22**. Thus, the operator indirectly performs the input operation at a desired key-entry point on the input operation surface **12** of the touch panel **14** via the input region **22** of the elastic plate-like member **16**. Therefore, according to the flat input keyboard **10**, due to the elastic deformation amount and/or elastic reaction force of the input region **22** and a region adjacent thereto of the elastic plate-like member **16**, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger, such as a keying stroke or a click feeling obtained in a characteristic key entry operation of a mechanical key switch. Since a keying operation is not performed directly on the input operation surface **12** of the touch panel **14** but on the outer surface **20** of the elastic plate-like member **16**, it is possible to reduce noise associated with the keying operation, and also mitigate impact on and/or fatigue of a finger of the operator. Further, since the keyboard **10** is configured simply by arranging a single piece of the elastic plate-like member **16** on the input operation surface **12** of the touch panel **14**, the equipment configuration is simplified compared to a keyboard including a plurality of discrete or separated mechanical key switches.

The input region **22** and non-input region **24** can be provided by various means in the elastic plate-like member **16**. Referring to FIGS. **2A-11**, various embodiments of keyboards will be described below, each including an elastic plate-like member provided with an input region and a non-input region formed by various means. The embodiments depicted in FIGS. **2A-11** have substantially the same configuration as the embodiment depicted in FIG. **1**, except for the specific configuration of means for forming the input region and the non-input region in the elastic plate like member, and for the specific configuration of the touch panel.

A flat input keyboard **30** depicted in each of FIGS. **2A-7** includes a resistive-type touch panel **34** having an input operation surface **32**, and an elastic plate-like member **36** disposed and superimposed on the input operation surface **32** of the touch panel **34**, the elastic plate-like member **36** being locally and elastically deformable by a pressing force applied thereto.

The resistive-type touch panel **34** includes a first electrode plate **42** including an electrically insulating substrate **38** and an electrically conductive coat or coating **40** provided on a surface of the substrate **38**, and a second electrode plate **48** including an electrically insulating substrate **44** and an electrically conductive coating or coating **46** provided on a surface of the substrate **44**, the first and second electrode plates **42**, **48** being combined with each other in a relative arrangement such that conductive coatings **40**, **46** are opposed to and spaced from each other while permitting a conductive contact between the conductive coatings **40**, **46**. A plurality of electrically insulating dot spacers **50** are arranged in a suitably dispersed manner between the mutually opposing conductive coatings **40**, **46** of the first and second electrode plates **42**, **48**. In the illustrated configuration, the second electrode plate **48** is disposed at an input side, and the rear surface of the substrate **44**, opposite to the conductive coating **46**, constitutes an input operation surface **32**. The substrate **38** of the first electrode plate **42** at a support side may be made of, for example, a glass plate, a plastic plate, or a plastic film, etc., and the substrate **44** of the second electrode plate **48** at the input side may be made of, for example, a plastic plate, a plastic film, etc.

Each of the first and second electrode plates **42**, **48** is provided, in an area extending along the outer periphery thereof, with a pair of strip-shaped positive and negative electrodes (i.e., a parallel electrode pair) formed in parallel to and spaced from each other on each conductive coating **40**, **46**, and electric conductors connected to the parallel electrode pair and formed on an insulating layer (not depicted) on each conductive coating **40**, **46**. To the respective conductive coatings **40**, **46** of the electrode plates **42**, **48**, a predetermined electric voltage is alternately applied via the associated conductors and parallel electrode pairs in directions perpendicular to each other. In this state, when an operator presses a desired point on the input operation surface **32** (i.e., when the operator performs a touch input) so as to bring the conductive coatings **40**, **46** locally into conductive contact with each other, a divided voltage corresponding to a resistance value of each conductive coating **40**, **46** is determined at the pressed point, and a two-dimensional coordinate value of the pressed point is thereby detected. The above-described method for detecting an input coordinate value has been known as an analog method. In this connection, a resistive-type touch panel executing a digital-type detecting method, in which the conductive coating of each electrode plate is divided into a plurality of strip portions on the surface of the substrate, may also be used as the touch panel **34**. The configuration of a resistive-type touch panel is known, and thus is not further explained in detail.

The elastic plate-like member **36** is a flat platy member similar to the elastic plate-like member **16** depicted in FIG. **1**, and includes an inner surface **52** facing the input operation surface **32** of the touch panel **34** and an outer surface (i.e., an exposed surface) **54** opposite to the inner surface **52** and not facing the input operation surface **32**. The elastic plate-like member **36** is provided with a plurality of input regions **56** and a non-input region **58**, corresponding respectively to the input regions **22** and the non-input region **24** depicted in FIG. **1**.

In the embodiment depicted in FIGS. **2A-2B**, the input regions **56** and the non-input region **58** are provided in the elastic plate-like member **36** as portions having mutually different shapes adapted to exhibit different elastic deformations by an equal pressing force. More specifically, each of the input regions **56** has a thickness less than a thickness of the non-input region **58**, and the elastic plate-like member **36** includes a recess **60** formed on the inner surface **52** and provided to each input region **56** due to a difference in thickness between the input region **56** and the non-input region **58**.

In the flat input keyboard **30** of FIGS. **2A-2B**, an operator can perform a keying operation to press a desired input region **56** of the elastic plate-like member **36** while referring to a key display (not depicted), such as a character, a number, a symbol, etc., indicated on the input region **56** (FIG. **2A**). The key display on each input region **56** can be indicated by, e.g., a screen display on a display unit (not depicted) provided on a side opposite to the input operation surface **32** of the touch panel **34** facing the elastic plate-like member **36**, a print display on the input operation surface **32** of the touch panel **34**, a print display on the elastic plate-like member **36**, an insertion of a printed sheet (not depicted), and so on.

The input region **56** elastically deforms in response to the keying operation by the operator and, when the pressing force of the keying operation exceeds a predetermined threshold value, accomplishes an input operation on the input operation surface **32** of the touch panel **34** at a position corresponding to the pressed or deformed input region **56**. The second electrode plate **48** of the resistive-type touch panel **34** is locally bent by the pressing force applied to the input operation surface **32** via the input region **56** of the elastic plate-like member **36**, and thereby the conductive coating **46** of the second electrode plate **48** comes into local contact with the conductive coating **40** of the first electrode plate **42** (FIG. **2**B). A signal processing section (not depicted) of the touch panel **34** detects a mutual contact of the conductive coatings **40**, **46** due to the keying operation by the operator, specifies a two-dimensional coordinate value of the position of the contact point by the aforementioned method, and thereby identifies the key (i.e., the input region **56**) subjected to the input operation.

According to the flat input keyboard **30** of FIGS. **2**A-**2**B, due to the elastic deformation amount and/or elastic reaction force of the input region **56** and a region adjacent thereto of the elastic plate-like member **36**, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger. In this connection, in the configuration depicted in FIGS. **2**A-**2**B, since the input region **56** is thinner than the non-input region **58** and the recess **60** is formed in the input region **56** on the inner surface **52** of the elastic plate-like member **36**, the input region **56** is elastically deformed more easily than the non-input region **58** under an equal pressing force. Therefore, the input region **56** permitting the input operation of the touch panel **34** and the non-input region **58** not permitting the input operation of the touch panel **34** can be formed by suitably selecting the size (in particular, the thickness) and the material of the elastic plate-like member **36** in such a manner that the range of the pressing force required to elastically deform the elastic plate-like member **36** to the extent sufficient to carry out the input operation of the touch panel **34** is, in the input region **56**, comparable to the range of a pressing force required to a key entry operation generally set in a keyboard having a mechanical key switch (the pressing force in this range is hereinafter referred to as a normal pressing force), while in the non-input region **58**, exceeds the normal pressing force (the pressing force in this range is hereinafter referred to as an excessive pressing force).

In the configuration of FIGS. **2**A-**2**B, an operating stroke defined from a state where an operator brings his finger into contact with the outer surface **54** of the elastic plate-like member **36** to a state where the operator presses to deform the input region **56** so as to complete the input operation, can be appropriately set by suitably selecting the difference in thickness between the input region **56** and the non-input region **58** (i.e., the depth of the recess **60**). The recess **60** may be formed in a mold during a molding process of the elastic plate-like member **36** in a case where the elastic plate-like member **36** has a unitary or one-piece structure, or alternatively may be formed when sheet materials of the elastic plate-like member **36** are stacked on each other in a case where the elastic plate-like member **36** has a laminated structure of the sheet materials. Since, in the configuration of FIGS. **2**A-**2**B, the input region **56** of the elastic plate-like member **36** is elastically deformed more easily as compared to the non-input region **58**, an operator can judge whether or not the input region **56** is accurately pressed or keyed, based on the operational feeling sensed at the tip of his finger.

The flat input keyboard **30** of FIGS. **2**A-**2**B may have a configuration wherein the dot spacers **50** of the touch panel **34** are arranged in such a manner that a density of the dot spacers **50** in a region corresponding to the input region **56** is lower than a density of the dot spacers **50** in a region corresponding to the non-input region **58**. As illustrated, substantially no dot spacer **50** may be arranged in the region corresponding to the input region **56**. According to the above configuration, it is possible to effectively prevent the touch panel **34** from being subjected to an input operation at the non-input region **58** even when a pressing force is applied to the non-input region **58**. Further, when a marginal part of the high-density dot spacers **50** arranged in the region corresponding to the non-input region **58** partially extends into the input region **56** as depicted, the input region **56** can exhibit a constant elastic deformation, and thus a variation in the operational feeling can be suppressed. If the elastic plate-like member **36** has a characteristic configuration that alone can clearly distinguish the input region **56** from the non-input region **58** by the operation characteristics and also can adequately prevent an erroneous input in the non-input region **58**, the dot spacers **50** may be arranged in a uniform density across the touch panel **34**.

In the flat input keyboard **30** of FIGS. **2**A-**2**B, the input region **56** and the non-input region **58** may have mutually different material properties (density, material, etc.). For example, the input region **56** and the non-input region **58** may be formed by molding the elastic plate-like member **36** through a two-color molding process, so as to provide the non-input region **58** with material properties more difficult to be elastically deformed than the input region **56**.

In the flat input keyboard **30** of FIGS. **2**A-**2**B, if an air is encapsulated in an air-tight manner in the recess **60** formed on the side of the inner surface **52** of the elastic plate-like member **36**, the keying operation characteristics of the input region **56** may be affected by an air spring due to the encapsulated air. From this viewpoint, a passage (not depicted) allowing air to flow between the recess **60** and the exterior of the keyboard **30** may be formed at a required position on the inner surface **52** of the elastic plate-like member **36**.

In the embodiment depicted in FIGS. **3** and **4** (i.e., a modification of the flat input keyboard **30** of FIGS. **2**A-**2**B), the input regions **56** and the non-input region **58** are provided in the elastic plate-like member **36** as portions having mutually different shapes adapted to exhibit different elastic deformations by an equal pressing force. More specifically, each of the input regions **56** has a thickness greater than a thickness of the non-input region **58**, and the elastic plate-like member **36** includes a protrusion **62** formed on the outer surface **54** and provided to each input region **56** due to a difference in thickness between the input region **56** and the non-input region **58**.

The flat input keyboard **30** of FIGS. **3** and **4** includes a display unit **64**, such as an LCD, provided on a side opposite to the input operation surface **32** of the touch panel **34** facing the elastic plate-like member **36**. The touch panel **34** and the elastic plate-like member **36** have optical transparency allowing a screen **66** of the display unit **64** to be visually recognized from the side of the outer surface **54** of the elastic plate-like member **36**. Thus, an operator can perform a keying operation to press a desired input region **56** of the elastic plate-like member **36** while referring to a key display shown on the screen **66** of the display unit **64**, which can be visually recognized in the input region **56** of the elastic plate-like member **36**. The input region **56** elastically deforms in response to the keying operation by the operator and, when the pressing force of the keying operation exceeds a predetermined threshold value, accomplishes an input operation on the input operation

surface **32** of the touch panel **34** at a position corresponding to the pressed or deformed input region **56**. The second electrode plate **48** of the resistive-type touch panel **34** is locally bent by the pressing force applied to the input operation surface **32** via the input region **56** of the elastic plate-like member **36**, and thereby the conductive coating **46** of the second electrode plate **48** comes into local contact with the conductive coating **40** of the first electrode plate **42**. A signal processing section of the touch panel **34** detects a mutual contact of the conductive coatings **40**, **46** due to the keying operation by the operator, specifies a two-dimensional coordinate value of the position of the contact point by the aforementioned method, and thereby identifies the key subjected to the input operation.

According to the flat input keyboard **30** of FIGS. **3** and **4**, due to the elastic deformation amount and/or elastic reaction force of the input region **56** and a region adjacent thereto of the elastic plate-like member **36**, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger. In this connection, in the configuration depicted in FIGS. **3** and **4**, since the input region **56** is thicker than the non-input region **58**, the input region **56** is more difficult to be elastically deformed than the non-input region **58** under an equal pressing force. On the other hand, since the protrusion **62** is formed in the input region **56** on the outer surface **54** of the elastic plate-like member **36**, the input region **56** can be more easily recognized in visual and tactile sense as the presence of the protrusion **62** on the outer surface **54**. When the keyboard **30** of FIGS. **3** and **4** is configured in accordance with a key arrangement for a conventional keyboard, the non-input region **58** formed between adjacent input regions **56** has relatively small area as compared to the input region **56**, so that an operator can accurately perform a keying operation to the input region **56**.

The flat input keyboard **30** of FIGS. **3** and **4** may have a configuration wherein the dot spacers **50** of the touch panel **34** are arranged in such a manner that a density of the dot spacers **50** in a region corresponding to the input region **56** is lower than a density of the dot spacers **50** in a region corresponding to the non-input region **58**, so that it is possible to effectively prevent the touch panel **34** from being subjected to an input operation at the non-input region **58** even when a pressing force is applied to the non-input region **58**. In this manner, it is possible to provide the input region **56** permitting the input operation of the touch panel **34** and the non-input region **58** not permitting the input operation of the touch panel **34**. Alternatively, the input region **56** and the non-input region **58** may have mutually different material properties (density, material, etc.). For example, the input region **56** and the non-input region **58** may be formed by molding the elastic plate like member **36** through a two-color molding process, so as to provide the non-input region **58** with material properties more difficult to be elastically deformed than the input region **56**.

In the configuration of FIGS. **3** and **4**, an operating stroke defined from a state where an operator brings his finger into contact with the outer surface **54** of the elastic plate-like member **36** (i.e., a top surface of the protrusion **62**) to a state where the operator presses to deform the input region **56** so as to complete the input operation, can be appropriately set by suitably selecting the difference in thickness between the input region **56** and the non-input region **58** (i.e., the height of the protrusion **62**). The protrusion **62** may be formed in a mold during a molding process of the elastic plate-like member **36** in a case where the elastic plate-like member **36** has a unitary or one-piece structure, or alternatively may be formed when sheet materials of the elastic plate-like member **36** are stacked on each other in a case where the elastic plate-like member **36** has a laminated structure of the sheet materials.

In the embodiment depicted in FIG. **5** (i.e., a modification of the flat input keyboard **30** of FIGS. **2A-4**), the input regions **56** and the non-input region **58** are provided in the elastic plate-like member **36** as portions having mutually different shapes adapted to exhibit different elastic deformations by an equal pressing force. More specifically, the elastic plate-like member **36** includes a recess **60** formed on the inner surface **52** and provided to each input region **56**, and a protrusion **62** formed on the outer surface **54** and provided to each input region **56** correspondingly to the recess **60**. Thus, the input region **56** is formed to have a rectangular cap shape bulging out in one direction relative to the non-input region **58**.

The flat input keyboard **30** of FIG. **5** includes a printed sheet **68** provided on a side opposite to the input operation surface **32** of the touch panel **34** facing the elastic plate-like member **36**. The touch panel **34** and the elastic plate-like member **36** have optical transparency allowing a printed surface **70** of the printed sheet **68** to be visually recognized from the side of the outer surface **54** of the elastic plate-like member **36**. Thus, an operator can perform a keying operation to press a desired input region **56** of the elastic plate-like member **36** while referring to a key display shown on the printed surface **70** of the printed sheet **68**, which can be visually recognized in the input region **56** of the elastic plate-like member **36**. The input region **56** elastically deforms in response to the keying operation by the operator and, when the pressing force of the keying operation exceeds a predetermined threshold value, accomplishes an input operation on the input operation surface **32** of the touch panel **34** at the position corresponding to the pressed or deformed input region **56**. In this embodiment, the method for identifying the key subjected to the input operation in the resistive-type touch panel **34** is the same as that described with reference to the embodiments of FIGS. **2A-4**.

According to the flat input keyboard **30** of FIG. **5**, due to the elastic deformation amount and/or elastic reaction force of the input region **56** and a region adjacent thereto of the elastic plate-like member **36**, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger. In this connection, in the configuration depicted in FIG. **5**, since the protrusion **62** is formed in the input region **56** on the outer surface **54** of the elastic plate-like member **36**, the input region **56** can be more easily recognized in visual and tactile sense as the presence of the protrusion **62** on the outer surface **54**. Further, since the recess **60** is formed in the input region **56** on the inner surface **52** of the elastic plate-like member **36**, the input region **56** is elastically deformed more easily than the non-input region **58** supported on the input operation surface **32** of the touch panel **34**, under an equal pressing force. Therefore, the input region **56** permitting the input operation of the touch panel **34** and the non-input region **58** not permitting the input operation of the touch panel **34** can be formed by suitably selecting the size (in particular, the thickness) and the material of the elastic plate-like member **36** in such a manner that the range of the pressing force required to elastically deform the elastic plate-like member **36** to the extent sufficient to carry out the input operation of the touch panel **34** is, in the input region **56**, comparable to the range of a pressing force required to a key entry operation generally set in a keyboard having a mechanical key switch (the pressing force in this range is hereinafter referred to as a normal pressing force), while in the non-input region **58**, exceeds the

normal pressing force (the pressing force in this range is hereinafter referred to as an excessive pressing force).

In the configuration depicted in FIG. **5**, an operating stroke defined from a state where an operator brings his finger into contact with the outer surface **54** of the elastic plate-like member **36** (i.e., a top surface of the protrusion **62**) to a state where the operator presses to deform the input region **56** so as to complete the input operation, can be appropriately set by suitably selecting the depth of the recess **60** and the height of the protrusion **62** in the input region **56**. The recess **60** and the protrusion **62** may be formed in a mold during a molding process of the elastic plate-like member **36** in a case where the elastic plate-like member **36** has a unitary or one-piece structure, or alternatively may be formed when sheet materials of the elastic plate-like member **36** are stacked on each other in a case where the elastic plate-like member **36** has a laminated structure of the sheet materials.

The flat input keyboard **30** of FIG. **5** may have a configuration similar to that of the embodiments of FIGS. **2**A-**4**, wherein the dot spacers **50** of the touch panel **34** are arranged in such a manner that a density of the dot spacers **50** in a region corresponding to the input region **56** is lower than a density of the dot spacers **50** in a region corresponding to the non-input region **58**, so that it is possible to effectively prevent the touch panel **34** from being subjected to an input operation at the non-input region **58** even when a pressing force is applied to the non-input region **58**. Alternatively, as depicted, the dot spacers **50** may be arranged in a uniform density across the touch panel **34**. Further, the input region **56** and the non-input region **58** may have mutually different material properties (density, material, etc.). For example, the input region **56** and the non-input region **58** may be formed by molding the elastic plate like member **36** through a two-color molding process, so as to provide the non-input region **58** with material properties more difficult to be elastically deformed than the input region **56**.

In the flat input keyboard **30** including a resistive-type touch panel **34**, as an embodiment depicted in FIG. **6**, the input region **56** permitting the input operation of the touch panel **34** and the non-input region **58** not permitting the input operation of the touch panel **34** can also be formed by simply arranging the dot spacers **50** of the touch panel **34** in such a manner that a density of the dot spacers **50** in a region corresponding to the input region **56** is lower than a density of the dot spacers **50** in a region corresponding to the non-input region **58**, even when the elastic plate-like member **36** having an entirely uniform configuration (shape, material, etc.) is used. Alternatively, as an embodiment depicted in FIG. **7**, the input region **56** permitting the input operation of the touch panel **34** and the non-input region **58** not permitting the input operation of the touch panel **34** can also be formed by simply forming the input region **56** and the non-input region **58** so as to have mutually different material properties (density, material, etc.) by molding the elastic plate-like member **36** through, for example, a two-color molding process, so as to provide the input region **56** with material properties more easy to be elastically deformed than the non-input region **58**, even when the dot spacers **50** of the touch panel **34** are arranged in a uniform density across the touch panel **34**, or when the elastic plate-like member **36** having an entirely uniform shape (in particular, thickness) is used.

As depicted in FIG. **7**, the flat input keyboard **30** may also include a signal processing section **72** adapted to cancel an input signal of the touch panel **34** generated in a region corresponding to the non-input region **58** of the elastic plate-like member **36**. The signal processing section **72** operates in accordance with a predetermined processing routine wherein, even if a pressing force is applied to the non-input region **58** and the conductive coatings **40**, **46** of the first and second electrode plates **42**, **48** of the touch panel **34** locally come into contact with each other by the pressing force applied to the input operation surface **32** via the non-input region **58**, an input signal obtained from the local contact between the conductive coatings **40**, **46** is cancelled so as not to specify an input position. According to this configuration, it is possible to reliably prevent the non-input region **58** from performing an input operation to the touch panel **34**. The signal processing section **72** may be provided in any of the embodiments of FIGS. **2**A-**6**.

A flat input keyboard **80** depicted in each of FIGS. **8**A-**12** includes a capacitive-type touch panel **84** having an input operation surface **82**, and an elastic plate-like member **86** disposed and superimposed on the input operation surface **82** of the touch panel **84**, the elastic plate-like member **86** being locally and elastically deformable by a pressing force applied thereto.

The capacitive-type touch panel **84** includes an electrically insulating substrate **88**, and a pair of electrically conductive coats or coatings **90**, **92** provided on opposite sides of the substrate **88**, each conductive coating **90**, **92** being divided into a plurality of strip parts (not depicted), wherein the strip parts of the conductive coating **90** are arranged so as to extend perpendicularly to the strip parts of the conductive coating **92**. In the illustrated configuration, one conductive coating **92** (on the upper side in the drawing) is disposed at an input side, and the surface of the substrate **88** with the conductive coating **92** provided thereon constitutes an input operation surface **82**. The substrate **88** is made of, for example, a glass plate, a plastic plate, etc.

A predetermined electric voltage is applied to a plurality of strip parts of respective conductive coatings **90**, **92**, and when an operator brings his finger close to or into contact with a desired point on the input operation surface **82** (i.e., when the operator performs a touch input), electric currents flowing in the strip parts of the respective conductive coatings **90**, **92** change as a function of a distance from the touched point, and a two-dimensional coordinate value of the touched point is detected based on the magnitude of the current change in each strip part. The above-described method for detecting an input coordinate value has been known as a projected capacitive technology. The touch panel **84** may include a capacitive-type touch panel having the other configuration, such as a capacitive-type touch panel using a projected capacitive technology in which a pair of conductive coatings each divided into a plurality of strip parts are provided on mutually opposed surfaces of two substrates, or a capacitive-type touch panel using a surface capacitive technology in which a conductive coating is provided uniformly across one surface of a single substrate. The configuration of the capacitive-type touch panel is known, and thus is not further explained in detail.

The elastic plate-like member **86** is a flat platy member similar to the elastic plate-like member **16** depicted in FIG. **1**, and includes an inner surface **94** facing the input operation surface **82** of the touch panel **84** and an outer surface (i.e., an exposed surface) **96** opposite to the inner surface **94** and not facing the input operation surface **82**. The elastic plate-like member **86** is provided with a plurality of input regions **98** and a non-input region **100**, corresponding respectively to the input regions **22** and the non-input region **24** depicted in FIG. **1**.

In the embodiment depicted in FIGS. **8**A-**8**B, the input regions **98** and the non-input region **100** are provided in the elastic plate-like member **86** as portions having mutually different shapes adapted to exhibit different elastic deforma-

tions by an equal pressing force. More specifically, each of the input regions **98** has a thickness less than a thickness of the non-input region **100**, and the elastic plate-like member **86** includes a recess **102** formed on the inner surface **94** and provided to each input region **98** due to a difference in thickness between the input region **98** and the non-input region **100**.

In the flat input keyboard **80** of FIGS. **8**A-**8**B, an operator can perform a keying operation to press a desired input region **98** of the elastic plate-like member **36** while referring to a key display (not depicted), such as a character, a number, a symbol, etc., indicated on the input region **98** (FIG. **8**A). The key display on each input region **98** can be indicated by, e.g., a screen display on a display unit (not depicted) provided on a side opposite to the input operation surface **82** of the touch panel **84** facing the elastic plate-like member **86**, a print display on the input operation surface **82** of the touch panel **84**, a print display on the elastic plate-like member **86**, an insertion of a printed sheet (not depicted), and so on.

The input region **98** elastically deforms in response to the keying operation by the operator and, when the pressing force of the keying operation exceeds a predetermined threshold value, accomplishes an input operation on the input operation surface **82** of the touch panel **84** at a position corresponding to the pressed or deformed input region **98** (FIG. **8**B). In the capacitive-type touch panel **84**, electric currents flowing in the aforementioned strip parts of the respective conductive coatings **90**, **92** change as a function of a change in distance between the finger pressing the input region **98** of the elastic plate-like member **86** and the conductive coatings **90**, **92** (i.e., a change in electrostatic capacitance). When the current change in each conductive coating **90**, **92** exceeds a predetermined threshold value, a signal processing section (not depicted) of the touch panel **84** specifies a two-dimensional coordinate value of the position of the pressed point by the aforementioned method, and thereby identifies the key (i.e., the input region **98**) subjected to the input operation.

According to the flat input keyboard **80** of FIGS. **8**A-**8**B, due to the elastic deformation amount and/or elastic reaction force of the input region **86** and a region adjacent thereto of the elastic plate-like member **86**, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger. In this connection, in the configuration depicted in FIGS. **8**A-**8**B, since the input region **98** is thinner than the non-input region **100** and the recess **102** is formed in the input region **98** on the inner surface **94** of the elastic plate-like member **86**, the input region **98** is elastically deformed more easily than the non-input region **100** under an equal pressing force. Therefore, the input region **98** permitting the input operation of the touch panel **84** and the non-input region **100** not permitting the input operation of the touch panel **84** can be formed by suitably selecting the size (in particular, the thickness) and the material of the elastic plate-like member **86** in such a manner that the range of the pressing force required to elastically deform the elastic plate-like member **86** to the extent sufficient to carry out the input operation of the touch panel **84** is, in the input region **98**, comparable to the range of a pressing force required to a key entry operation generally set in a keyboard having a mechanical key switch (the pressing force in this range is hereinafter referred to as a normal pressing force), while in the non-input region **100**, exceeds the normal pressing force (the pressing force in this range is hereinafter referred to as an excessive pressing force).

In the configuration of FIGS. **8**A-**8**B, an operating stroke defined from a state where an operator brings his finger into contact with the outer surface **96** of the elastic plate-like member **86** to a state where the operator presses to deform the input region **98** so as to complete the input operation, can be appropriately set by suitably selecting the difference in thickness between the input region **98** and the non-input region **100** (i.e., the depth of the recess **102**). The recess **102** may be formed in a mold during a molding process of the elastic plate-like member **86** in a case where the elastic plate-like member **86** has a unitary or one-piece structure, or alternatively may be formed when sheet materials of the elastic plate-like member **86** are stacked on each other in a case where the elastic plate-like member **86** has a laminated structure of the sheet materials. Since, in the configuration of FIGS. **8**A-**8**B, the input region **98** of the elastic plate-like member **86** is elastically deformed more easily as compared to the non-input region **100**, an operator can judge whether or not the input region **98** is accurately pressed or keyed, based on the operational feeling sensed at the tip of his finger.

In the flat input keyboard **80** of FIGS. **8**A-**8**B, the input region **98** and the non-input region **100** may have mutually different material properties (density, material, etc.). For example, the input region **98** and the non-input region **100** may be formed by molding the elastic plate-like member **86** through a two-color molding process, so as to provide the non-input region **100** with material properties more difficult to be elastically deformed than the input region **98**.

In the flat input keyboard **80** of FIGS. **8**A-**8**B, if an air is encapsulated in an air-tight manner in the recess **102** formed on the side of the inner surface **94** of the elastic plate-like member **86**, the keying operation characteristics of the input region **98** may be affected by an air spring due to the encapsulated air. From this viewpoint, a passage (not depicted) allowing air to flow between the recess **102** and the exterior of the keyboard **80** may be formed at a required position on the inner surface **94** of the elastic plate-like member **86**.

In the embodiment depicted in FIG. **9** (i.e., a modification of the flat input keyboard **80** of FIGS. **8**A-**8**B), the input regions **98** and the non-input region **100** are provided in the elastic plate-like member **86** as portions having mutually different shapes adapted to exhibit different elastic deformations by an equal pressing force. More specifically, each of the input regions **98** has a thickness greater than a thickness of the non-input region **100**, and the elastic plate-like member **86** includes a protrusion **104** formed on the outer surface **96** and provided to each input region **98** due to a difference in thickness between the input region **98** and the non-input region **100**.

The flat input keyboard **80** of FIG. **9** includes a display unit **106**, such as an LCD, provided on a side opposite to the input operation surface **82** of the touch panel **84** facing the elastic plate-like member **86**. The touch panel **84** and the elastic plate-like member **86** have optical transparency allowing a screen **108** of the display unit **106** to be visually recognized from the side of the outer surface **96** of the elastic plate-like member **86**. Thus, an operator can perform a keying operation to press a desired input region **98** of the elastic plate-like member **86** while referring to a key display shown on the screen **108** of the display unit **106**, which can be visually recognized in the input region **98** of the elastic plate-like member **86**. The input region **98** elastically deforms in response to the keying operation by the operator and, when the pressing force of the keying operation exceeds a predetermined threshold value, accomplishes an input operation on the input operation surface **82** of the touch panel **84** at a position corresponding to the pressed or deformed input region **98**. In the capacitive-type touch panel **84**, electric currents flowing in the aforementioned strip parts of the

respective conductive coatings **90**, **92** change as a function of a change in distance between the finger pressing the input region **98** of the elastic plate-like member **86** and the conductive coatings **90**, **92** (i.e., a change in electrostatic capacitance). When the current change in each conductive coating **90**, **92** exceeds a predetermined threshold value, a signal processing section of the touch panel **84** specifies a two-dimensional coordinate value of the position of the pressed point by the aforementioned method, and thereby identifies the key (i.e., the input region **98**) subjected to the input operation.

According to the flat input keyboard **80** of FIG. **9**, due to the elastic deformation amount and/or elastic reaction force of the input region **98** and a region adjacent thereto of the elastic plate-like member **86**, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger. In this connection, in the configuration depicted in FIG. **9**, since the input region **98** is thicker than the non-input region **100**, the input region **98** is more difficult to be elastically deformed than the non-input region **100** under an equal pressing force. On the other hand, since the protrusion **104** is formed in the input region **98** on the outer surface **96** of the elastic plate-like member **86**, the input region **98** can be more easily recognized in visual and tactile sense as the presence of the protrusion **104** on the outer surface **96**. When the keyboard **80** of FIG. **9** is configured in accordance with a key arrangement for a conventional keyboard, the non-input region **100** formed between adjacent input regions **98** has relatively small area as compared to the input region **98**, so that an operator can accurately perform a keying operation to the input region **98**.

In the flat input keyboard **80** of FIG. **9**, the input region **98** and the non-input region **100** may have mutually different material properties (density, material, etc.). For example, the input region **98** permitting the input operation of the touch panel **84** and the non-input region **100** not permitting the input operation of the touch panel **84** may be formed by molding the elastic plate like member **86** through a two-color molding process, so as to provide the non-input region **100** with material properties more difficult to be elastically deformed than the input region **98**.

In the configuration of FIG. **9**, an operating stroke defined from a state where an operator brings his finger into contact with the outer surface **96** of the elastic plate-like member **86** (i.e., a top surface of the protrusion **104**) to a state where the operator presses to deform the input region **98** so as to complete the input operation, can be appropriately set by suitably selecting the difference in thickness between the input region **98** and the non-input region **100** (i.e., the height of the protrusion **104**). The protrusion **104** may be formed in a mold during a molding process of the elastic plate-like member **86** in a case where the elastic plate-like member **86** has a unitary or one-piece structure, or alternatively may be formed when sheet materials of the elastic plate-like member **86** are stacked on each other in a case where the elastic plate-like member **86** has a laminated structure of the sheet materials.

In the embodiment depicted in FIG. **10** (i.e., a modification of the flat input keyboard **80** of FIGS. **8A-9**), the input regions **98** and the non-input region **100** are provided in the elastic plate-like member **86** as portions having mutually different shapes adapted to exhibit different elastic deformations by an equal pressing force. More specifically, the elastic plate-like member **86** includes a recess **102** formed on the inner surface **94** and provided to each input region **98**, and a protrusion **104** formed on the outer surface **96** and provided to each input region **98** correspondingly to the recess **102**. Thus, the input region **98** is formed to have a rectangular cap shape bulging out in one direction relative to the non-input region **100**.

The flat input keyboard **80** of FIG. **10** includes a printed sheet **110** provided on a side opposite to the input operation surface **82** of the touch panel **84** facing the elastic plate-like member **86**. The touch panel **84** and the elastic plate-like member **86** have optical transparency allowing a printed surface **112** of the printed sheet **110** to be visually recognized from the side of the outer surface **96** of the elastic plate-like member **86**. Thus, an operator can perform a keying operation to press a desired input region **98** of the elastic plate-like member **86** while referring to a key display shown on the printed surface **112** of the printed sheet **110**, which can be visually recognized in the input region **98** of the elastic plate-like member **86**. The input region **98** elastically deforms in response to the keying operation by the operator and, when the pressing force of the keying operation exceeds a predetermined threshold value, accomplishes an input operation on the input operation surface **82** of the touch panel **84** at the position corresponding to the pressed or deformed input region **98**. In this embodiment, the method for identifying the key subjected to the input operation in the capacitive-type touch panel **84** is the same as that described with reference to the embodiments of FIGS. **8A-9**.

According to the flat input keyboard **80** of FIG. **10**, due to the elastic deformation amount and/or elastic reaction force of the input region **98** and a region adjacent thereto of the elastic plate-like member **86**, it is possible to ensure keying operation characteristics that enable an operator to realize and recognize a key entry operation by an operational feeling on a finger. In this connection, in the configuration depicted in FIG. **10**, since the protrusion **104** is formed in the input region **98** on the outer surface **96** of the elastic plate-like member **86**, the input region **98** can be more easily recognized in visual and tactile sense as the presence of the protrusion **104** on the outer surface **96**. Further, since the recess **102** is formed in the input region **98** on the inner surface **94** of the elastic plate-like member **86**, the input region **98** is elastically deformed more easily than the non-input region **100** supported on the input operation surface **82** of the touch panel **84**, under an equal pressing force. Therefore, the input region **98** permitting the input operation of the touch panel **84** and the non-input region **100** not permitting the input operation of the touch panel **84** can be formed by suitably selecting the size (in particular, the thickness) and the material of the elastic plate-like member **86** in such a manner that the range of the pressing force required to elastically deform the elastic plate-like member **86** to the extent sufficient to carry out the input operation of the touch panel **84** is, in the input region, comparable to the range of a pressing force required to a key entry operation generally set in a keyboard having a mechanical key switch (the pressing force in this range is hereinafter referred to as a normal pressing force), while in the non-input region **100**, exceeds the normal pressing force (the pressing force in this range is hereinafter referred to as an excessive pressing force).

In the configuration depicted in FIG. **10**, an operating stroke defined from a state where an operator brings his finger into contact with the outer surface **96** of the elastic plate-like member **86** (i.e., a top surface of the protrusion **104**) to a state where the operator presses to deform the input region **98** so as to complete the input operation, can be appropriately set by suitably selecting the depth of the recess **102** and the height of the protrusion **104** in the input region **98**. The recess **102** and the protrusion **104** may be formed in a mold during a molding process of the elastic plate-like member **86** in a case where the elastic plate-like member **86** has a unitary or one-piece structure, or alternatively may be formed when sheet materials of

the elastic plate-like member **86** are stacked on each other in a case where the elastic plate-like member **86** has a laminated structure of the sheet materials.

In the flat input keyboard **80** of FIG. **10**, the input region **98** and the non-input region **100** may have mutually different material properties (density, material, etc.). For example, the input region **98** permitting the input operation of the touch panel **84** and the non-input region **100** not permitting the input operation of the touch panel **84** may be formed by molding the elastic plate like member **86** through a two-color molding process, so as to provide the non-input region **100** with material properties more difficult to be elastically deformed than the input region **98**.

In the flat input keyboard **80** including a capacitive-type touch panel **84**, as an embodiment depicted in FIG. **11**, the input region **98** of the elastic plate-like member **86** may be provided with an auxiliary conductive coating **114** electrically insulated from the conductive coatings **90**, **92** of the touch panel **84**. In the illustrated configuration, the auxiliary conductive coating **114** is provided on the bottom face of the recess **102** provided to the input region **98** on the inner surface **94** of the elastic plate-like member **86**. When the auxiliary conductive coating **114** is provided in the input region **98**, change in electrostatic capacitance between a finger pressing the input region **98** and the conductive coatings **90**, **92** is increased as compared to a configuration provided with no auxiliary conductive coating **114**, so that the sensitivity of the touch panel **84** is increased and thus the stroke of a keying operation is reduced (i.e., the sensitivity of the flat input keyboard is improved).

In the flat input keyboard **80** including an capacitive-type touch panel **84**, as an embodiment depicted in FIG. **12**, the input region **98** permitting the input operation of the touch panel **84** and the non-input region **100** not permitting the input operation of the touch panel **84** can also be formed by simply forming the input region **56** and the non-input region **58** so as to have mutually different material properties (density, material, etc.) by molding the elastic plate-like member **86** through, for example, a two-color molding process, so as to provide the input region **98** with material properties more easy to be elastically deformed than the non-input region **100**, even when the elastic plate-like member **86** having an entirely uniform shape (in particular, thickness) is used.

As depicted in FIG. **12**, the flat input keyboard **80** may also include a signal processing section **116** adapted to cancel an input signal of the touch panel **84** generated in a region corresponding to the non-input region **100** of the elastic plate-like member **86**. The signal processing section **116** operates in accordance with a predetermined processing routine wherein, even if a pressing force is applied to the non-input region **100** due to a keying operation by an operator and a change in electric current flowing each of the conductive coatings **90**, **92** caused due to the keying operation exceeds a predetermined threshold value, an input signal obtained from the change in electric current exceeding the threshold value is cancelled so as not to specify an input position. According to this configuration, it is possible to reliably prevent the non-input region **100** from performing an input operation to the touch panel **84**. The signal processing section **116** may be provided in any of the embodiments of FIGS. **8A-11**.

The present invention is not limited to the configurations depicted above. For example, a keyboard according to an aspect of the present invention may have various key arrangements other than the key arrangement depicted in the drawings. For example, a keyboard according to an aspect of the present invention may be embodied as various input devices provided with a switch subjected to a keying or pressing operation, such as a remote control unit usable for an audio-visual apparatus or other home appliances.

While the invention has been described with reference to specific embodiments, it will be understood by those skilled in the art that various changes and modifications may be made thereto without departing from the scope of the following claims.

The invention claimed is:

1. A keyboard comprising:

a touch panel, including

first and second electrode plates separated by a plurality of dot spacers, each electrode plate including a substrate and a conductive coating provided on a surface of the substrate with the conductive coating of the first electrode plate facing the conductive coating of the second electrode plate,

an input region capable of accepting input operation of said touch panel, and

a non-input region that does not accept input operation of said touch panel, a first density of the dot spacers arranged in the non-input region being higher than a second density of the dot spacers arranged in the input region; and

an elastic plate-like member, disposed on said touch panel, having a substantially flat outer surface and including first and second portions corresponding to and extending across said input region and said non-input region, respectively, the first portion having an entirely uniform first thickness less than a second thickness of the second portion.

2. The keyboard of claim **1**, wherein a recess is formed on an inner surface of the elastic plate-like member facing said touch panel so as to correspond to the first portion, said recess being provided correspondingly to said input region due to a difference in thickness between the first portion and the second portion.

3. The keyboard of claim **1**, wherein said input region and said non-input region comprise mutually different material properties.

4. The keyboard of claim **1**, wherein said touch panel comprises a pair of electrode plates each including a substrate and a conductive coating provided on a surface of the substrate, the pair of electrode plates being combined with each other in a relative arrangement such that conductive coatings are opposed to and spaced from each other while permitting a conductive contact between the conductive coatings, and wherein the keyboard further comprises a signal processing section adapted to cancel an input signal of said touch panel in a region corresponding to said non-input region of said elastic plate-like member.

5. The keyboard of claim **1**, wherein said touch panel comprises a single conductive coating or a pair of conductive coatings arranged to be opposed to and insulated from each other, and wherein the keyboard further comprises a signal processing section adapted to cancel an input signal of said touch panel in a region corresponding to said non-input region of said elastic plate-like member.

6. The keyboard of claim **5**, wherein said input region of said elastic plate-like member is provided with an auxiliary conductive coating insulated from said conductive coatings of said touch panel.

7. The keyboard of claim **1**,

wherein the elastic plate-like member is elastically deformable by a pressing force, and

wherein first elastic characteristics of the first portion of the elastic plate-like member differ from second elastic characteristics of the second portion of the elastic plate-like member.

8. The keyboard of claim **1**, further comprising a display unit on which the touch panel is arranged, the display unit displaying on the input region a key display including at least one of a character, a number and a symbol.

9. The keyboard of claim **1**, wherein no dot spacer is located in the input region.

10. The keyboard of clam **1**, wherein high-density dot spacers arranged in the non-input region partially extend into the input region.

11. The keyboard of claim **1**, wherein said elastic plate-like member has an uneven inner surface extending across the first and second portions.

12. A keyboard comprising:

a touch panel, including

first and second electrode plates separated by a plurality of dot spacers, each electrode plate including a substrate and a conductive coating provided on a surface of the substrate with the conductive coating of the first electrode plate facing the conductive coating of the second electrode plate,

an input region capable of accepting input operation of said touch panel, and

a non-input region that does not accept input operation of said touch panel, a first density of the dot spacers arranged in the non-input region being higher than a second density of the dot spacers arranged in the input region; and

an elastic plate-like member, disposed on said touch panel, having a substantially flat outer surface and including first and second portions corresponding to and extending across said input region and said non-input region, respectively, the first and second portions differing in thickness, the first portion being spaced from a surface of the touch panel and responding to pressure on the first portion by contacting the surface of the touch panel.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 9,349,551 B2
APPLICATION NO.	: 13/596554
DATED	: May 24, 2016
INVENTOR(S)	: Takashi Nakajima

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims:

Claim 10, Column 19, Line 11
Delete "clam" and insert --claim--, therefor.

Signed and Sealed this
Sixth Day of September, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office